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THE TEACHER AS RE-DESIGNER OF TECHNOLOGY INTEGRATED ACTIVITIES FOR AN EARLY LITERACY CURRICULUM

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ABSTRACT

Though popular among children outside of school, Dutch teachers often struggle to offer technology integrated activities in the kindergarten classroom. Because involving teachers in development of technology integrated activities can support their implementation, this study examines teachers in the role of re-designing such activities. Two case studies (Year 1 and Year 2) were undertaken in two consecutive years involving six teachers in re-design. Interviews were held to examine teacher team perceptions about their role as re-designers. Implementation of the re-designed activities was

observed in five classes. A non-equivalent control quasi experimental design was used to investigate pupil learning outcomes (Year 1: N = 102; Year 2: N = 119). Pupils in experimental groups outperformed pupils in control groups on early literacy. While the extent of integration increased as implementation continued, this could not explain the differences found in learning gains.

INTRODUCTION

Technology integration forms a challenge for many teachers. This is often difficult due to unclear teacher-student roles, which affect teacher perceptions concerning the relevance and benefits of technology integration for their classrooms (Ertmer, 2005). Also, teacher struggles to integrate technology in classrooms are commonly exacerbated by the a lack of: planning time (Bauer & Kenton, 2005), and/or an active role in determining the importance of technology integration (Keengwe & Onchwari, 2009). The absence of teacher involvement in decision making regarding technology integrated curricula causes a gap between expected and

actual curriculum implementation (Tondeur, van Braak & Valcke, 2007). Observations like this have prompted a shift from perceiving teachers as merely receivers of technology tools to perceiving them as active participants in re-designing curriculum to integrate technology (Parette, Quesenberry & Blum, 2010). When determining the impact of ICT-activities on student learning, such activities cannot not be isolated from other activities in a learning environment (Kennewell, 2001; Lim, 2002).

An active role in which teachers, together with colleagues, plan for implementation and create ICT-activities for pupils can possibly be fruitful for actual implementation (Keengwe & Onchwari, 2009; Riel & Becker, 2008). Teacher involvement in design creates a sense of ownership and commitment to a curriculum (cf. Fullan, 2003). One way to involve teachers in curriculum development, while accounting for limited teacher time available, is involving teachers in collaborative *re*-design of existing materials. The re-designer role enables teachers to address challenges and possibilities in ICT-integration; have a clear voice in design; while investing modest time and effort. As discussed in the following section, the role of re-designer may be fruitful for fostering the sense of ownership which can contribute to integrating ICT-activities in the classroom.

Teacher Role as Re-designer

Re-designing has parallels with something teachers do on a daily basis: adaptation. However, we use the term re-design in our case to emphasize the proactive work of adaptive planning, in contrast to making changes on the fly (which could also constitute adaptation). When re-designing, teachers examine and reflect on existing activities and materials; set goals for re-design; discuss and change activities to meet the re-design goals; and discuss how to implement the re-designed activities. Kenny and McDaniel (2011) found that teacher involvement in exploration of technology positively affected teacher's judgments and expectations about the value of technology. Through hands-on opportunities involving actual integrated lessons, teachers can begin to identify the relevance and learn about successful implementation of ICT-activities (Keengwe & Onchwari, 2009). While Kenny and McDaniel (2011) note that identifying relevance and envisioning scenarios for implementation are preconditions for teacher motivation to integrate technology, they also suggest that successful implementation of ICT-activities correlates with teachers views about what is *feasible*, and not necessarily with positive views about technology.

Teacher feasibility concerns have been well-examined. Doyle and Ponder (1978) refer to this issue as 'the practicality ethic' and

identify three salient components. First, teachers consider how well specified an innovation is. Second, teachers consider the relation between the effort they invest (costs) and the benefits of the innovation for their classroom. And third, teachers consider how congruent the innovation is with their convictions, classroom setting and specific students. Through participation in development, teachers naturally attend to these issues, thus directly increasing the practicality of an innovation. In addition, involvement in development may foster teacher ownership of the developed innovation (Kirk & MacDonald, 2001), which could also positively influence their sense of feasibility/practicality. Finally, designing ICT-activities can help primary school teachers reflect on and develop their own ideas about their teaching (Angeli & Valanides, 2009).

Re-designing ICT-activities in a team allows for sharing understanding of what must be revised, based on what teachers view feasible in their classes and what effort is needed for implementation. Team-based development can result in teachers' taking co-ownership of the innovation. However, the team-outcome is also influenced by the team-based process, for example, team functioning (Tillema & van der Westhuizen, 2006), design skills and expertise, team leadership, team size and time (Crow & Pounder, 2000).

Involving teams of teachers in developing ICT-activities may help teachers gain understanding about the curriculum at hand (Koehler & Mishra, 2005), and shape a shared belief about the innovation, as one's own views may also be guided by the views of teachers as a group (Kenny & McDaniel, 2011). According to Penuel, Roschelle and Shechtman (2007), teacher teams can work with developers to create an implementable innovation in which technology is used in order to meet a common educational goal. The present study was undertaken to understand better the role of teacher as re-designer. It involved teachers in a team to re-design PictoPal and examined their perceptions about co-ownership, curriculum quality and practicality as well as their perceptions on team re-design. In addition implementation of the re-designed activities was examined along with pupil learning.

Context of this study: Re-designing PictoPal activities

In this study, teachers re-design and use PictoPal activities. PictoPal is a learning environment designed to stimulate early literacy development through meaningfully integrated on-and off computer activities. In line with good practice concerning technology use with young children, PictoPal activities are integrated in everyday activities, and not separate (cf. Sheridan & Pramling Samuelson, 2003). PictoPal focuses on four Dutch

national attainment goals for early literacy (1) functional reading and writing (2) function of written language (3) relationship between spoken and written language and (4) language consciousness. One set of PictoPal learning activities consists of eight on-computer activities to compose and construct small texts, each with a corresponding off-computer application activity in which the printed text is used for fully authentic purposes (e.g. a weather forecast is given to the class) or semi-authentic purposes (e.g. as essential props in role-play, [cf. Brooker, 2003]).

In the on-computer activity shown in Figure 1, children compose letters; and in the off-computer activity shown in Figure 2, children mail their letters. PictoPal activities can be changed by teachers who wish to attune them to specific learner needs and/or curricular goals. In this study, teachers re-designed an existing set of PictoPal activities related to springtime to fit with winter themes. Besides the thematic change, teachers wanted the re-designed materials to explicitly stimulate independent work while also building on pupil prior knowledge and vocabulary.

Figure 1. On-computer activity: Composing invitation letter

Figure 2. Off-computer activity: Children mailing the letters

METHOD

A case study method (Yin, 2003) was used to study teacher perceptions and implementation of their re-designed PictoPal activities. A pre-test post-test quasi experimental design was used to examine the impact of the re-designed activities on pupils early

literacy learning outcomes. The question guiding this study was: *What does teacher involvement in re-designing technology integrated activities, imply for implementation and learning outcomes?*

The findings of this study are presented following these sub-questions:

1. What are teacher team perceptions about collaborative re-design of a technology integrated activities for an early literacy curriculum?
2. What are teacher perceptions about their role as re-designer and their co-ownership?
3. What are teacher perceptions about quality and practicality of the re-designed activities?
4. How do teachers implement the re-designed activities?
5. What are pupil learning outcomes?

Participants and Intervention

This study was conducted in the Netherlands in one primary school with three campuses. In one campus, a team of kindergarten teachers (n = 6) re-designed PictoPal activities which were then implemented during eight weeks. The intervention took place twice during two years. The first time (Year 1) four teachers (Iris,

Mira, Diana, and Fiona) re-designed PictoPal to fit the curriculum thematically. Two teachers, Iris and Mira, implemented the re-designed activities in their kindergarten classes. The other two teachers were not involved in implementation because they were no longer teaching kindergarten during that time. The second time (Year 2) four teachers (Alice, Jet, Diana, and Fiona) re-designed Year 1-PictoPal activities to simplify implementation by lowering the difficulty and thereby enabling pupils to work more independently. In Year 2, three teachers (Diana, Jet and Alice) implemented the re-designed activities. Fiona was not involved in implementation.

Prior to Year 1 two teachers (Diana and Fiona) experienced PictoPal-implementation during eight weeks (see also Author, 2012), two teachers (Mira and Iris) had not experienced PictoPal. Table 1 shows an overview of participants in Year 1, their teaching experience in years and experiences with PictoPal prior to Year 1-re-design. Table 2 shows an overview of the Year 2-participants with their experiences in teaching and PictoPal. Both tables indicate how many pupils were in the classes of teachers implementing PictoPal and how many from the other two campuses participated in control groups. To study the impact of PictoPal on pupil learning, 102 pupils participated in Year 1 (experimental condition N = 49; control condition = 53) and 119

pupils in Year 2 (experimental condition $N = 65$; control condition = 54). Control group pupils and experimental group pupils come from one primary school, with three campuses in which teachers use same language curriculum. Also, teachers of the control and experimental groups have similar teaching experience and have common goals, pedagogy and assessment regarding language education in the kindergarten, which they align through frequent team meetings. National language test scores (administered shortly before the intervention), indicate that pupil language skills were comparable in the experimental and the control group. All pupils, whether in the experimental or control group, used computers on a regular basis for learning with educational software accompanying the language curriculum and for other subject areas. One set of on-computer and off-computer PictoPal activities was used in the experimental group; no treatment was given in the control group.

Table 1. Participants in Year 1(experimental condition)

Teachers involved in re-design	Teaching experience	PictoPal experience prior to Year 1	Pupils per class (Exp.)
Fiona	33	Implementation prior to Year 1	NA
Diana	13	Implementation prior to Year 1	NA
Iris	2	none	24
Mira	3	none	25

NA not applicable, because the teachers did not implement PictoPal

Table 2. Participants in Year 2 (experimental condition)

Teachers involved in re-design	Teaching experience	PictoPal experience prior to Year 1and -Year 2	Pupils per class (Exp.)
Fiona	33	Implementation prior to Year 1 and re-design prior to Year 2	NA
Alice	23	Implementation prior to Year 1 and prior to Year 2	24
Diana	14	Implementation prior to Year 1 and re-design prior to Year 2	22
Jet	6	None	19

NA not applicable, because the teachers did not implement PictoPal

Procedure and Instruments

Teachers agreed to come together to re-design activities linked to the theme of Winter. In each year (1 and 2, respectively), four teachers participated in re-design. In Year 1, the main revision was content. In Year 2, teachers' main aim was to render PictoPal (a)

more suitable for the junior kindergarteners and (b) easier for children to use PictoPal independently. Both teams spent nine hours in total on re-design. In both years PictoPal was implemented during eight weeks.

Teachers were interviewed about working in a team, including how they perceived the team: functioning, value, activities,-expertise, leadership, focus, and skills to re-design technology integrated activities. Also, teachers were interviewed about their re-designer role, Pictopal activity quality and practicality.

The implementation of PictoPal-activities was observed by two researchers using the Integration Checklist (Verseput, 2008), which consists of 12 items measuring the extent of integration of the on- and off -computer activities. The items relate to (1) involving pupils, (2) initiating listening, (3) initiating speaking, (4) initiating writing, (5) An example item is: “The teacher creates the opportunity for pupils to talk about their products”. Each observation of an activity took approximately 20 minutes. The items were scored on a 3-point scale with 0 indicating the target behaviour is absent, .5 indicating the behaviour is observable to some extent, and 1 indicating the target behaviour is observable to a great extent. The inter-rater reliability based on ratings of two raters indicated sufficient agreement Cohens’ kappa = .71. Pupils

were pre- and post-tested using an early literacy test for 4-5 year olds (Author, 2006).

Data Analysis

Interviews were first summarized per question and then responses between teachers were compared and contrasted. The observation data was analysed using analyses of variance (ANOVA) to examine the hypothesis that there was no difference in implementation between teachers. The similarity of the groups was determined by scores on a Dutch national language test for kindergarteners. Analyses of covariance (ANCOVA) was used to test the hypothesis that there were no differences between the control and experimental groups as well as the hypothesis that there were no differences between the PictoPal-classes.

RESULTS

Re-design

When asked about working in a team, teachers of both teams were positive. They valued the experience they had with classroom practices in kindergarten. Team 1 (Year 1) especially

appreciated the exchange of ideas; while team 2 (Year 2) was more motivated by the perceived need to re-design the PictoPal activities. Team 2 teachers acknowledged the value of collaborating in a team to understand PictoPal thoroughly, which supported teacher decisions when later implementing the activities. Team activities were intense. Teachers of both teams felt sufficiently skilled to re-design the activities. Teachers shared their perceptions about a shared goal, focus and leadership in a team. In Table 3 team perceptions about re-design team Year 1 and -Year 2 are shown.

Table 3. Team perceptions of Year 1 and Year 2 - re-design team

	Year 1 team	Year 2 team
Working in a team/team functioning, and value of a team	*Positive, because have already worked as a kindergarten team on curricular decisions *Exchange of ideas and proposals adds to the value of a team	* Teachers complement each other in a re-design team, due to the existing working relations and cooperation *Positive. Re-design for differentiation was a necessary step

Team activities	*Call for creativity, working intensively on pupil-oriented content, structure and alignment with the audio and visual possibilities *Shared goal, confidence in the final product *Understanding re-design structure	*Clear, small framework, positive about team size: working in a small team *Teachers goals and principles were aligned, because of shared understanding of kindergarten class practice *Much time was spent on certain aspects, yet every time something useful came out of it
Team expertise	*Sufficient for the re-design because teachers differ in experience with teaching and adapting curriculum *No need for the presence of a language expert	*Same expertise, homogenous team, because all share experience with teaching kindergarten *Teachers had same approach, aimed at kindergarteners, several years of experience with kindergarteners

Team leadership and focus in a team	*Shared due to equal teacher participation, joint setting of re-design objectives and plan	* Shared leadership, Fiona lead a team organisationally
Skills to re-design the on- and off-computer activities	*Skilled to adapt their kindergarten curriculum to the pupils of their classrooms, but felt that the adaptation of the activities was new for them	* Skilled to re-design

Re-designer Role and Co-ownership

When asked about their role as re-designer, teachers of the Year 1 team reported that, although the re-design purpose and procedure was explained, the process was new. They perceived their new understanding about re-design to be an enrichment of their skills. Teachers' understanding about re-design can be related to the choices teachers made on what to include as revisions; and the links between the re-designed activities and their existing language curriculum. In team discussions, teachers reasoned about their proposals in relation to the re-design goals (more emphasis on activities suitable for junior kindergarteners and enabling pupils to

work more independently). Also, teachers discussed how the re-designed activities fit into existing curriculum thematically and how to connect them. Teachers reported taking responsibility for content, vocabulary, and difficulty level. These teacher perceptions can be related to the responsibility for re-design, which teachers were expected to take in their role as re-designer. Specifically, the perception relates to team discussion about how the proposed activities would elicit enthusiasm and meaningful engagement in kindergarteners.

Only Mira reported questioning herself during the re-design as to why she took on the responsibility. She explained that she dealt with doubts about her role:

> *"I have nothing against team work, on the contrary I am in favour of re-designing kindergarten activities as it is fun and fruitful for learning. I was not sure about the purpose of re-design… was the purpose to help curriculum makers adapt curriculum?"*

From Mira's perspective the responsibility for re-design does not fit the task of a teacher. Fiona, Diana, Iris, Alice and Jet perceived re-designing technology integrated activities as being not a regular practice of teachers. Year 1 teachers compared their

role as re-designer with the situation in which the kindergarten teacher team adapts the curriculum to the classroom composition and particular pupil needs. Year 1 teachers perceived the team product as co-owned, because of the joined responsibility for product re-design.

Year 2 teachers described their role as thinking along with a team. Teachers perceived themselves as contributors to a shared view about re-design goals, and ways to meet those goals. Alice felt that creative thinking is one of her strengths. She also knows what is possible with her kindergarteners, and felt able to offer realistic suggestions for re-design. Jet was particularly focused on elements attuned to the needs of junior kindergarteners, and evaluated suggested activities in light of how junior kindergarteners would execute them. Jet was especially concerned with feasibility, by considering if implementation would even be possible. In her view, the role of re-designer makes a teacher reflect about one's own actions, classroom organization, and practical knowledge. Jet felt that:

> "*Re-designing can be an endless task, at a certain moment you have to be content with the end product.*"

Teachers felt the commitment of the team was excellent, because teacher collaboration was found important, regardless of what the task at hand is. Year 2 teachers felt little co-ownership, because in their view they have only contributed ideas, which were written on paper during re-design and afterwards incorporated into pupil on- and off -computer activities.

Activity Quality and Practicality

When asked about activity quality, Year 1 teachers reported confidence about implementation, as the re-designed activities met the goals teachers intended and because the re-designed activities were written in teachers guides with possible suggestions meant to support implementation. For teachers, this implied that the quality of the re-designed activities was good. Year 2 teachers felt they succeeded in the re-design, because the re-designed activities were appealing to kindergartners and were aligned with pupil world view. All teachers were confident about the quality of the team end product, but Jet, involved for the first time in re-design, felt the end product should be reviewed by an expert.

During re-design teachers questioned the practicality of PictoPal, on the other hand they saw during implementation that kindergarteners enjoyed working with the learning environment. In their view, kindergarteners should rather engage independently with PictoPal. Even though teachers re-designed activities in Year

2 to fit better to junior kindergarteners, teachers felt that children were able to conduct the activities completely independently. They concluded that PictoPal is more usable for gifted children, because then no adult guidance is needed.

When asked about their practicality considerations, Year 1 teachers felt they were intensively involved, but that the efforts put into collaborative re-design were in balance with the expected pay offs in their classrooms. Also, Year 2 teachers felt that efforts invested in re-design were sufficient for the expected pay offs in the classroom.

Jet found that the invested time was necessary to thoroughly re-design activities, so that both junior and senior kindergarteners could work on their own level. This means that re-design also involved teacher considerations about congruency with classroom/pupil needs: how congruent the activities are with the junior and senior kindergarteners level.

Alice felt that:

> *"re-design was not a burden, although it was intensive and you needed to be fully concentrated. The benefit was knowing PictoPal, so that it is easier to implement."*

Implementation

All five teachers involved in re-design implemented the on- and off -computer activities during eight weeks. The first off-computer activity was not implemented by Alice and Jet and the sixth off-computer activity was not implemented by Jet due to time constraints. Kindergarteners took home the products of the first and sixth on- computer activities (*1. List of favourite winter clothes and 6. A letter to a relative*).

Table 4 shows the overall integration mean scores over eight activities with standard deviations per class to describe the extent to which integrated Year 1 or Year 2 activities with other elements of class work and instruction. We expected that teacher involvement in re-design would have an impact on the start of implementation, that the teachers involved would start with comparable levels of integration.

In the 1st week, teachers' extent of integration seemed to vary much more than in the 8th week. To reveal any differences between teachers in the overall extent of integration, an ANOVA was performed. This showed, however, no significant differences, probably due to standard deviations. Teachers scoring relatively low on integration (for instance Alice and Jet) had large standard deviations.

Table 4. Teachers implementing PictoPal per Year, their classes and numbers of pupils and teacher integration of on-and off -computer activities overall means and standard deviations

Teacher	Classes and pupils (*n*)	Integration (*n* = 8) Mean *(SD)*
Year 1		
Iris	Junior class (24)	6.69 (1.44)
Mira	Junior class (25)	7.63 (2.03)
Year 2		
Jet	Junior class (19)	5.38 (4.38)
Diana	Senior class (22)	8.13 (1.30)
Alice	Senior class (24)	5.13 (3.10)

However, significant mean differences between teachers were observed on the integration items 'initiating writing' F (4, 32) = 5,898, $p < .05$, $\eta^2 = .42$ and 'play with writings' F (4, 32) = 4,059, $p < .05$, $\eta^2 = .34$. Figure 3 shows the distribution of the mean scores on twelve integration items for the five classes in which

teachers and children were observed during eight off-computer activities. From the graph, it appears that in each class quite similar integration mean score was reached. To reveal between-class differences in initiating writing, a post hoc test was performed. This showed that teacher Iris M = .63, SD = .23 was observed to encourage kindergarteners to write during applications of the printed computer products and that accordingly in her class children engaged in writing more than it was observed in class of Jet M = .17, SD = .40, Diana M = .25, SD = .27, and Alice M = .43, SD = .36. Also, Mira M = .75, SD = .27 scored significantly higher on initiating writing than Jet, Diana and Alice. Mira M = .86, SD = .35 and Diana M = .94, SD = .18 scored significantly higher on encouraging kindergarteners to play with writings they had previously produced on computers than Iris M = .56, SD = .18 and Alice M = .50, SD = .29. The teacher emphasis differed thus only when looking at specific items measuring integration of activities.

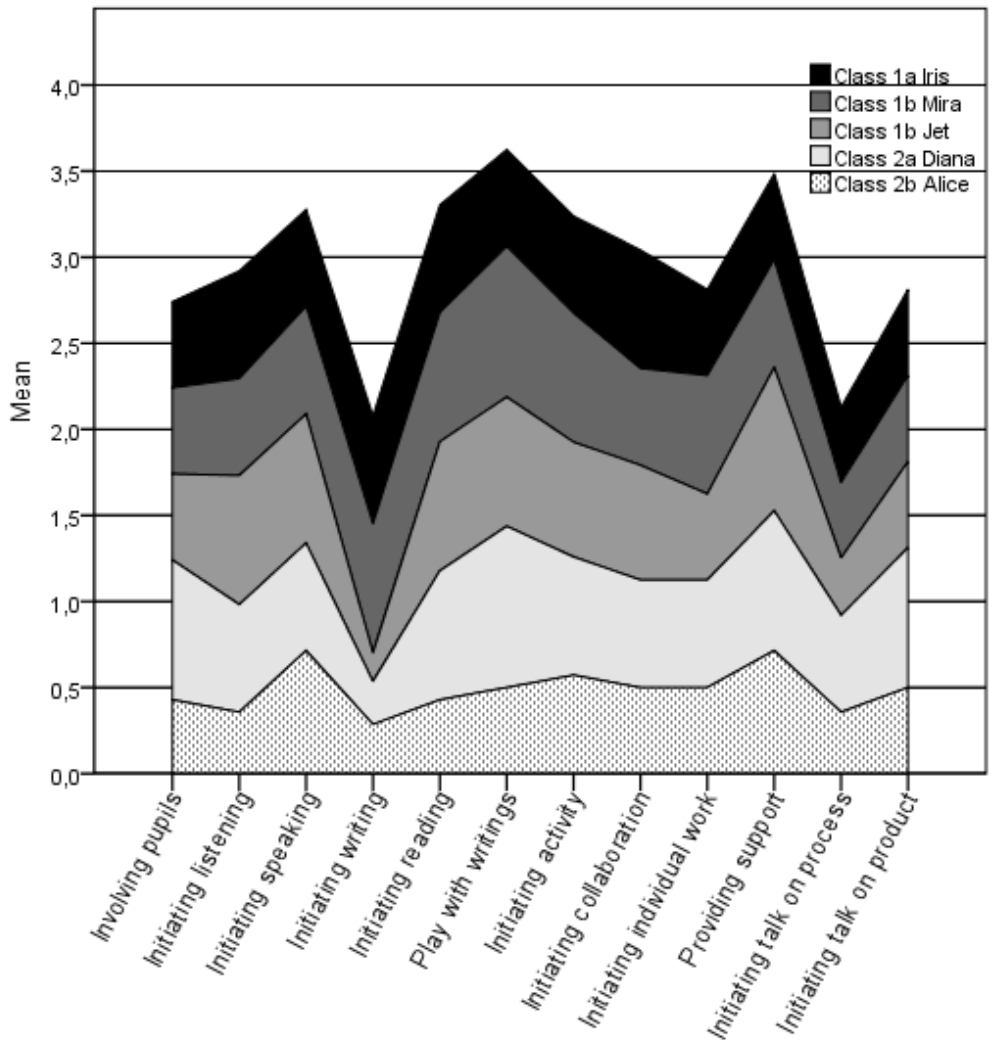

Figure 3. Distribution of mean scores per class on the items of integration of eight on-and off -computer activities

In Figure 4, the extent of integration is shown over the time of eight weeks that the five teachers implemented eight successive PictoPal-activities in their classrooms. To reveal how implementation changed over time, a regression analysis was performed. Although the extent of integration increased over the

time of eight weeks Iris, Diana, Alice and Jet work with PictoPal, time was not a significant predictor for their integration. Only for Mira could a significant proportion of variance in implementation be explained by time R^2 = .72, F (1, 6) = 15.25, p < .05. For teachers Alice and Jet, a proportion of variance in integration explained by time was low and non-significant, respectively R^2 = .51 and R^2 = .16. However, as Jet did not implement activities 1 and 6, this result should be interpreted with caution. This teacher joined the school that year and was not acquainted with the language curriculum, which could explain her reported constraints for not implementing activities 1 and 6. The extent of integration by Alice and Jet varied much from week to week and was dependent of the activity they implemented. This could mean that Alice and Jet might have experimented during the eight weeks with how to implement PictoPal. Also, for Iris and Diana, the proportion of variance in integration explained by time was low and non-significant, respectively R^2 = .11 and R^2 = .11. This result could be explained by their relatively high integration means at the start of implementation, which appear to stay stable across activities. Iris and Diana started with relatively high means of integration and had low standard deviations and thus could not improve much. Diana (experienced with PictoPal re-design and implementation) and Alice (experienced in implementation only)

seemed to evolve differently during Year 2 implementation. Diana appeared to start with a relatively high extent of integration and to maintain a certain extent throughout the activities (*SD* = 1.30); while Alice started relatively low and varied much in integration during implementation (*SD* = 3.10). The implementation findings identify little on how teacher involvement in re-design teams affected implementation or changes in extents of integration over time.

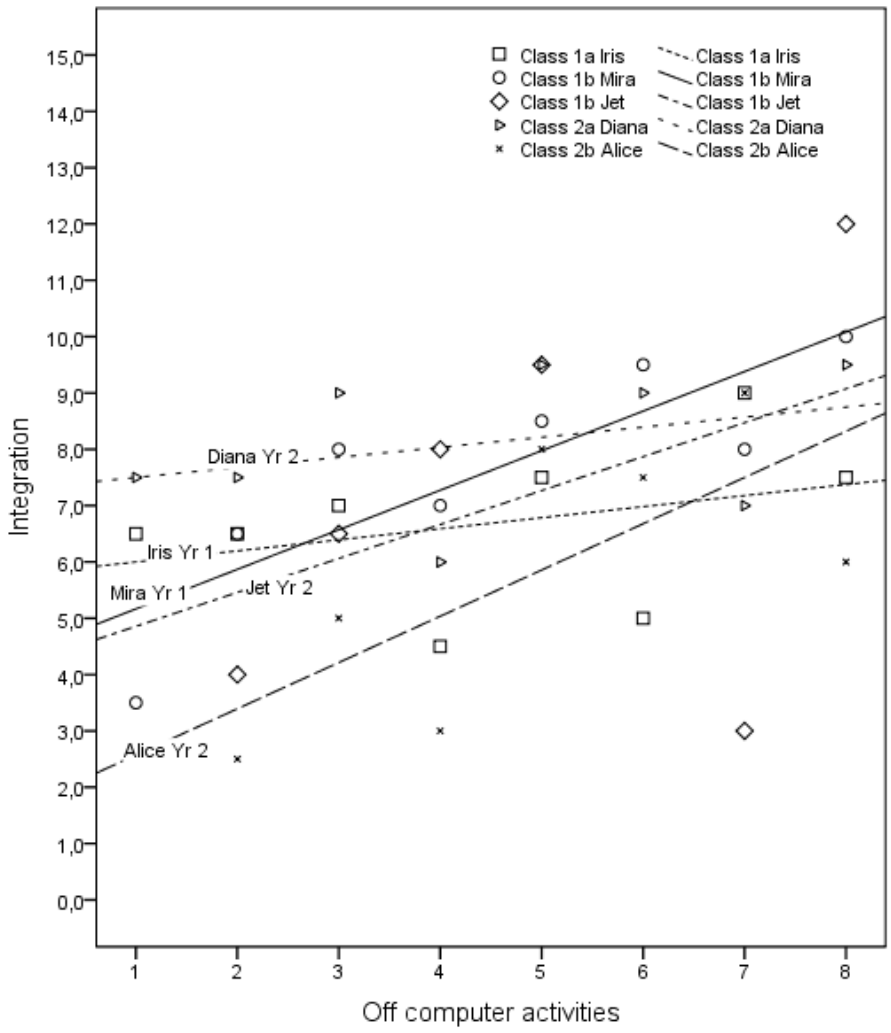

Figure 4. The integration of the eight off-computer activities in each class

Pupil Learning with PictoPal activities Year 1 and Year 2

Tables 5 and 6 show the number of pupils, the mean score and the standard deviation of the early literacy pre- and post-test of the experimental and control groups of Year 1 and Year 2. To reveal impact of PictoPal Year 1 on pupil early literacy, an ANCOVA was conducted with Year 1 pre-post differences as dependent

variable, group (Year 1 experimental and control group) as independent variable, and scores on the national language test as a covariate. This showed a significant difference for group F (1, 92) = 10,645, $p < .05$, $\eta^2 = .10$. The learning gains of pupils from the experimental group (pupils from classes of Iris and Mira) M = 4.13, SD = 2.70 were higher than the learning gains of pupils from the control group M = 1.96, SD = 2.70. An ANCOVA with Year 2 pre-post differences as dependent variable, group (Year 2 experimental and control group) as independent variable, and scores on the national language test as a covariate showed a significant difference for group F (1, 106) = 10,395, $p < .05$, $\eta^2 = .09$. The learning gains of pupils from the experimental group (pupils from classes of Jet, Diana and Alice) M = 2.96, SD = 2.92 were higher than the learning gains of pupils from the control group M = 1.10, SD = 3.65.

Table 5. Number of pupils, means, standard deviations and effect sizes of experimental and control group Year 1

	Pre test		Post test		Learning gain		Effect size
	n	*M (SD)*[a]	*n*	*M (SD)*	*n*	*M (SD)*	Cohen's *d*
Experimental group	45	9.24 (3.12)	50	13.38 (3.50)	45	4.13 (3.09)*	1.25
Control group	54	11.26 (3.59)	45	13.00 (3.27)	50	1.96 (2.70)	.58

*Significant at the alpha level of 0.05

[a] Adjusted for national language test scores

Table 6. Number of pupils, means, standard deviations and effect sizes of experimental and control group Year 2

	Pre test		Post test		Learning gain		Effect size
	n	*M (SD)* [a]	*n*	*M (SD)*	*n*	*M (SD)*	Cohen's *d*
Experimental group	58	12.36 (3.24)	58	15.40 (2.65)	57	2.96 (2.92)*	1.03
Control group	53	14.17 (2.94)	53	15.09 (3.13)	52	1.10 (3.65)	.30

* Significant at the alpha level of 0.05

[a] Adjusted for national language test scores

Pupil learning per classroom with PictoPal activities Year 1 and Year 2

Table 7 shows an overview of the number of pupils, the pre- and post-test mean scores, standard deviations and effect sizes per classroom. To reveal differences for classes an ANCOVA was

performed with pre-post differences as dependent variable, Year 1-classes (classes of Iris and Mira) as an independent variable, and scores on the national language test as a covariate. This showed a significant difference for class F (1, 42) = 5,062, $p < .05$, $\eta^2 = .11$. The learning gains of pupils from the class of Iris $M = 5.08$, $SD = 2.73$, $n = 24$ were higher than the learning gains of pupils from the class of Mira $M = 3.05$, $SD = 3.17$, $n = 21$. An ANCOVA with pre-post differences as dependent variable, Year 2-classes (class of Jet, class of Diana, and class of Alice) as an independent variable, and scores on the national language test as a covariate showed a significant difference for class F (2, 53) = 5,455, $p < .05$, $\eta^2 = .17$. The learning gains of pupils from the class of Jet $M = 4.88$, $SD = 2.39$, $n = 17$ were higher than the learning gains of pupils from the classes of Diana $M = 1.64$, $SD = 2.54$, $n = 22$ and Alice $M = 2.78$, $SD = 2.94$, $n = 18$.

Table 7. Number of pupils, means, standard deviations and effect sizes of teachers as re-designers classes

Teacher	Class pupils (*n*)	Pupil learning			
		Pre-test *M (SD)* [a]	Post-test *M (SD)*	Learning gain *M (SD)*	Cohen's *d*
Year 1					
Iris	Junior class (24)	9.48 (2.65)	14.42 (3.59)	5.08 (2.73)*	1.57
Mira	Junior class (25)	9.14 (3.69)	11.84 (3.12)	3.05 (3.17)	.79
Year 2					
Jet	Junior class (19)	9.63 (2.24)	14.55 (2.42)	5.00 (2.38)*	2.11
Diana	Senior class (22)	13.77 (2.39)	15.17 (2.93)	1.64 (2.54)	.52
Alice	Senior class (24)	13.38 (3.25)	16.17 (2.41)	2.78 (2.94)	.98

*Significant at the level 0.05

[a] Adjusted for national language test scores

DISCUSSION

This study aimed to gain a better understanding of the implications of teacher involvement in the re-design of technology integrated activities for implementation and pupil learning. For design of curricular experiences and teacher professional development the findings about teacher team perceptions imply that teachers collaboration is grounded in existing team functioning, shared team leadership, shared understanding of kindergarten practice, and common goals. Also, the finding that teachers were convinced of being skilled to re-design activities and have enough expertise in their team implies that the role as a re-designer is proximal to a daily teacher role, yet also suggests that teachers might overstate their actual skills to re-design ICT-integrated activities. Teacher appreciation for the small team size suggests re-design teams should remain small to foster focus and productivity. Also, when supporting re-design teams teacher experience with ICT-integrated activities could account for teacher perceptions about team activities.

When involving teachers in re-designing, the re-design activity should contain discussion about the role of re-designer, especially about how that the role carries responsibilities for content, activity purposes and alignment between content and goals. Also,

researchers should explicitly explain the purpose(s) of the re-designer role

Teacher considerations of re-designing in the light of their satisfaction with the team-product seems to be an important aspect for this role. Teachers could be supported in reflecting about how a re-designed product meets intended goals, how satisfied teachers are with the interim product and what time and effort it takes to reach the product teachers expect to be ready for implementation. Such interim reflection moments could help teachers monitor their re-design tasks and define how they will know if/when they are satisfied with the end product.

Teacher involvement in re-design seems to have a mixed effect on teacher perceptions about the role. The role of re-designer seems to provide teachers with an opportunity to collectively reach an understanding about the activities and to how to implement them. The role of re-designer allowed for informed judgment concerning the pupils for whom the activities are best suited. The value of the role of re-designer lies in collaboration on pupil learning and creating activities relevant for teachers. Being in the role of re-designer of PictoPal, adaptations required more (collaborative) work on coherency between structure, content, technology, planning and classroom practice compared to the work in the existing kindergarten team. In line with Lloyd and

McRobbie (2005) and Levin and Wadmany (2006) this study suggests situating teacher understanding in a context and content of their regular classroom practice as a powerful act through which integration of ICT in classrooms can be supported. The relevance of the role as re-designer for teacher work could be sustained by providing collaborating teachers with support and opportunities in their schools that enable them to continue.

After this study, teachers continued implementation of both Year-1- and Year-2- activities in kindergarten classes. Also, teachers of one of the other campuses started to implement PictoPal activities, which can be an indication that the sense of co-ownership is shared throughout the school. The continuation indicated that teachers do feel co-owner of the re-designed activities and that sustainability can be expected in these schools campuses.

The finding that teachers in this study were positive about the practicality and quality of curriculum activities they had re-designed is in accordance with the finding that teacher judgments and expectations about technology-rich activities are affected by their involvement in exploration of technology (Kenny & McDaniel, 2011). However, this study indicates another factor influencing teacher considerations about the practicality of activities. Specifically, implementation of PictoPal- Year 1seemed

to affect teachers practicality considerations concerning the level of guidance required by junior kindergarteners to work independently, because after implementation of Year 1, activities were re-designed to better suit junior kindergarteners needs and enable them to use PictoPal more independently. Also, teacher perceptions after Year 2 implementation in which they felt that PictoPal might be more suitable for talented pupils could suggests that prior to implementation, teachers expected to reach independent pupil performance, which was not met after actual implementation. From implementation findings it cannot be identified how teacher involvement in re-design teams could have affected integration or changes in extents of integration over time while they worked with PictoPal. Results showed that teachers did not differ on the overall integration. An explanation for this result could be the small sample size. A larger sample size could add to the strength of this conclusion. Teacher prior experience with the implementation of PictoPal did not have a differential impact on integration, as for instance Alice who had experience with PictoPal implementation did not integrate better than other teachers. Teachers were found to be equally prepared to implement PictoPal, yet they progressed differently during the eight weeks of implementation. The finding that for one teacher the extent of integration during the eight weeks increases, implies individual

differences in integration over time, namely that some teachers could be expected to be able to improve the extent of integration. Other teachers (Diana and Iris) started with high integration and could not improve much. Also, high versus low standard deviations of integration scores implies that teachers develop differently during the eight weeks. This study suggests that there might be different groups of teachers within the way they implement PictoPal: a teacher who improved integration (Mira), teachers who are stable over eight weeks (Iris and Diana), and those who vary considerably in their extent of integration across activities (Jet and Alice).

The shared understanding of the re-designed activities and the perception that re-design is beneficial for implementation could have contributed to the integration. Thanks to other team members, teachers might have experimented to find adequate ways to implement PictoPal in their practice. Fullan (2002) calls early difficulties of trying something new an 'implementation dip', which teachers can experience during initial implementation and suggests that continuous support during this time is important. Support from re-design team-members and experimentation with the innovation in existing practice could be a possible explanation for the finding that some teachers start with low extent of integration, subsequently vary across activities, yet do not

considerably differ from colleagues. Teachers who improved integration considerably in the eight weeks could have had profit from the available support from re-design team members.

In all classes, medium or large effect sizes were reached for pupil learning gains. Only significantly higher learning gains were found for the junior pupils of Iris and Jet. Also for these junior classes large effect sizes were found. This could mean that junior classes profit more from PictoPal than senior classes do. The junior learning gains cannot easily be explained by the extent their teachers' integration. There seems to be no relationship between the way teachers develop during implementation (during eight weeks) and the differences found in attainment. This is in line with the finding in the study of Author (2012) that high integration means do not relate to high pupil learning gains. Both Year 1 and Year 2 activities yielded enhanced early literacy learning gains compared to the control groups.

The study suggests that when teachers are involved in re-design of activitites, pupils appear to learn well. Teachers in the experimental condition implemented all of the planned activities, but the extent of integration of the activates varied. For the teachers who varied substantially in their score across weeks (Mira, Alice and Jet), it might have been possible to find differences in integration means if the duration had been longer

than eight weeks. Also, the study suggests that the teachers involved in re-design tend to grow differently during implementation, and that the differences in development are not explanatory for differences in pupils leaning gains. Differences in learning gains are more likely related to pupil factors than to the extent of integration. Active participation in re-design might have informed teaching early literacy, for instance enhanced awareness of and good practices related to language teaching and as such be considered as a professional development opportunity possibly contributing to changes in classroom practice. In order to control for this factor, a larger study could be needed. Also, additional observations of the degree and nature of early literacy learning opportunities teachers and parents offer, could be insightful for an explanation.

Since this study suggests that being involved in re-designing technology-rich activities can be fruitful for teacher experiences of co-ownership, a subsequent study could explore what kind of involvement appeals to teachers and encourages full responsibility for (re-)design. For example, the collaborative design of completely new activities could give teachers more freedom but also more responsibility. By experimenting with the role of co-designer, teachers might accept and develop this role alongside their existing role as classroom teacher (Carlgren, 1999). Teacher

voice in curriculum development and teacher collaboration on designing new activities can result in an implementable innovation (Kirk & MacDonald, 2011; Penuel et al., 2007), sense of co-ownership of the innovation and sustained curriculum use (Fullan, 2003). This study demonstrates that the role of re-designer is a viable approach to teacher involvement which can yield an implementable innovation that is co-owned by the participants and used for a longer period of time.

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